



ATTACHMENT A

Remarks

Claims 1, 2, 5-10, 15 and 16 stand pending in the present application. By this Amendment, Applicants have amended claim 1 and canceled claims 11-14. Applicants respectfully submit that the present application is in condition for allowance based on the discussion which follows.

Claims 1, 11, 12, 15 and 16 were rejected under 35 U.S.C. § 102(b) as being anticipated by Schwabe U.S. Patent No. 3,977,925. Claims 5, 9 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Schwabe in view of McCollister et al U.S. Patent No. 4,273,826 (hereinafter "McCollister"), and claims 2, 6 and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Schwabe in combination with either Grant et al U.S. Patent No. 5,439,553 (hereinafter "Grant") or Wanlass U.S. Patent No. 3,997,381.

In order to more clearly recite the etching solution with the claimed etch rate ratio, Applicants have amended claim 1 to recite that the inorganic acid has a pKa at 25°C of about 2 and the organic acid, inorganic acid or organic solvent member has a content range from 70 to 99.9% by weight. Subject matter basis for the amendment to claim 1 can be found in the claims previously examined, namely now canceled claims 11 and 12. In addition, subject matter basis for the inorganic acid having a pKa at 25°C of about 2 is disclosed in the specification on page 8, line 13. The 70 to 99.9% by weight content of the at least one member selected from the group consisting of an organic acid, inorganic acid and organic solvent is disclosed in the specification on page 8, line 12, and therefore, does not constitute new matter.

Applicants respectfully submit that the now recited etching solution is not taught or suggested by the prior art. The present etching solution includes at least one member of the group consisting of an organic acid, an inorganic acid having a pKa value of 25°C of about 2 and an organic solvent having a hetero atom, whose content range is from 70 to 99.9% by weight. As will be apparent to one of ordinary skill in the art and further disclosed in the present specification, examples of inorganic acids which are now outside the claimed pKa of about 2 includes hydrochloric acid (pKa = -8), nitric acid (pKa = -1.8), hydrobromic acid (pKa = -9), hydroiodic acid (pKa = -10) and perchloric acid (a pKa is an unmeasurably strong acid) (see specification, page 5, lines 7-12).

The tables in the specification summarizing the disclosed examples demonstrate the relevance of the claimed pKa range and the at least 70% by weight concentration of the organic acid, inorganic acid or organic solvent constituent which result in the claimed etch rate. See, e.g., pages 13-20 of the specification.

- (i) Table on page 13, entitled "HF-H₂O-isopropyl alcohol (IPA) etchant" 70% of IPA (Ex. 2) results in 21 of BPSG/THOX selectivity. 50% or lower of IPA (examples 3 and 4) result in less than 20 etch rate ratio of BSG or BPSG / THOX. Similarly, 70% IPA (Ex. 7) results in 28 of BPSG/THOX selectivity. 60% of IPA (Ex. 8) result in less than 20 etch rate ratio (i.e. 15) of BSG / THOX.

- (ii) Table on page 14, entitled "HF-H₂O-acetic acid etchant"
68.75% of acetic acid (Ex. 19) results in 21 etch rate ratio of
BSG/THOX selectivity. 70% or more of acetic acid will surely result in
more than 20 etch rate ratio of BSG/THOX.
- (iii) Table on page 15, entitled "HF-H₂O-tetrahydrofuran (THF) etchant"
70% of THF (Ex. 23) results in 22 etch rate ratio of BSG/THOX
selectivity and 27 of BPSG/THOX selectivity. 50% or lower of THF
(examples 24 and 25) result in less than 20 etch rate ratio of BSG or
BPSG / THOX.
- (iv) Table on page 16, entitled "HF-H₂O-acetone etchant"
70% of acetone (Ex. 27) results in 22 etch rate ratio of
BPSG/THOX selectivity. 50% or lower of THF (examples 28 and 29)
result in less than 20 etch rate ratio of BSG or BPSG / THOX.
- (v) Table on page 17, entitled "HF-H₂O-methanol etchant"
94%, 90% and 80% of methanol (Ex. 30, 31 and 32) result in 88, 57
and 33 etch rate ratio of BSG/THOX selectivity. Between 94% and 90% of
methanol, BSG/THOX selectivity is sharply changed. Between 90% and
80% of methanol, BSG/THOX selectivity is moderately changed. It will be
easily predicted that 70% of methanol will result in more than 20 etch rate
ratio of BSG/THOX.

This table shows that 90% ethanol has more than 20, i.e., 36 of BSG/THOX ratio
and 30 of BPSG/THOX ratio.

As shown above, 70% of organic acid, sulfuric acid and an organic solvent having a hetero atom is critical or closely related to 20 or higher of an etch rate ratio of BSG or BPSG / THOX at 25°C.

The prior art fails to teach or suggest the now claimed etching solution. Schwabe discloses a liquid etchant composed of a mixture of HF, HNO₃, CH₃COOH and H₂O wherein for every 4 grams of HF present in the mixture, there are 100 grams of HNO₃, 110 grams of CH₃COOH and 20 grams of H₂O.

In contrast, HNO₃ is excluded from the etching solution of the present invention as it has a pKa of about -1.8. Therefore, the invention is distinguishable from Schwabe.

The BSG etch rate of the etching solution of the present invention is preferably about 40-500 nm/min (see, page 10, lines 5 to 7 of the specification). In contrast, etching solution containing 68.6% of HNO₃ has a BSG etch rate of 5300 Å/min, equal to 530 nm/min, i.e., outside of the preferable range.

HNO₃ is not a preferable component because of high BSG etch rate.

McCollister disclose a solution containing 1.2 ml of 47 wt% solution of HF in water, 7.6 ml of a 37 wt% of HCl in water and 112 ml of alcohol consisting of 90.2 wt% ethanol, 4.8 wt% methanol, and 5 wt% isopropanol.

First, HCl is excluded from the claimed invention, because HCl has a pKa of -8, not about 2.

Second, as shown in table on page 20 of the specification, BSG/THOX selectivity is up to 26. Since HCl is a volatile acid, HCl concentration can not be increased to improve BSG/THOX selectivity.

Based on the foregoing, Applicants respectfully submit that the present invention is not anticipated or obvious in view of the prior art. Therefore, Applicants respectfully request that the prior art rejection to the claims under 35 U.S.C. §§ 102(b) and 103(a) be withdrawn.

In view of the foregoing, Applicants respectfully submit that the present application is in condition for allowance.

END REMARKS

ATTACHMENT B
Amendments to the Claims

Please cancel claims 11-14 without prejudice or disclaimer

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) An etching solution comprising:

- (i) hydrofluoric acid;
- (ii) water in a concentration of 30% by weight or lower; and
- (iii) at least one member selected from the group consisting of an organic

acid, an inorganic acid having a pKa at 25°C of about 2 and an organic solvent having a hetero atom, whose content ranges ~~from 30~~ from 70 to 99.9% by weight,

wherein the etching solution has a ratio of an etch rate of a boron silicate glass film (BSG) or boron phosphosilicate glass / an etch rate of a thermal oxide film (THOX) at 25°C of 20 or higher.

2. (Previously Presented) The etching solution according to claim 1, wherein

the organic solvent has a relative dielectric constant of 61 or lower.

3. (Cancelled)

4. (Cancelled)

5. (Currently Amended) The etching solution according to claim 1, wherein the organic solvent is isopropyl alcohol and the etching solution has a constituent ratio of HF : isopropyl alcohol : water by 0.1-50% by weight : 30-99% by weight : 0-70% by weight.

6. (Currently Amended) The etching solution according to claim 1, wherein the organic acid is acetic acid and the etching solution has a constituent ratio of HF : acetic acid : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

7. (Currently Amended) The etching solution according to claim 1, wherein the organic solvent comprises tetrahydrofuran and the etching solution has a constituent ratio of HF : tetrahydrofuran : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

8. (Currently Amended) The etching solution according to claim 1, wherein the organic solvent is acetone and the etching solution has a constituent ratio of HF : acetone : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

9. (Currently Amended) The etching solution according to claim 1, wherein the organic solvent comprises methanol and the etching solution has a constituent ratio of HF : methanol : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

10. (Currently Amended) The etching solution according to claim 1, wherein
the organic solvent comprises ethanol and the etching solution has a constituent ratio of
~~HF : ethanol : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.~~

11. (Canceled)

12. (Canceled)

13. (Canceled)

14. (Canceled)

15. (Previously Presented) A method for producing an etched article by
etching an article to be etched with the etching solution as defined in claim 1.

16. (Original) An etched article which is obtainable by the method of claim 15.